



CAP LM-series

Solar charge controller

User Manual



Thank
you very much for buying this
CAP product. Please read the
instructions carefully and
thoroughly before using the
products.

Your new LM controller is a state-of-the art device which was developed in accordance with the latest available technical standards. It comes with a number of outstanding features, such as:

1. Clear, readable display of the state of charge
2. Acoustic signal when the state of charge changes
3. Low voltage disconnect regulated by state of charge or voltage
4. 20 mm² connector clamps maximum
5. Complete electronic protection

Please read this manual carefully taking special note of the safety and usage recommendations at the end. The manual gives important recommendations for installing, using and programming as well as a troubleshooting guide for potential problems with the controller.

Description of Functions

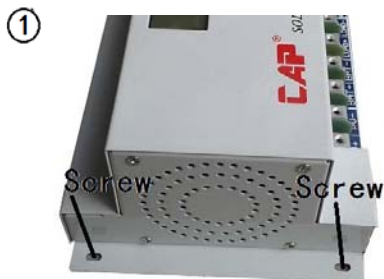
1. The charge controller protects the battery from being overcharged by the solar array and from being deep discharged by the Loads. The charging characteristics include several stages which include automatic adaptation to the ambient temperature.
2. The charge controller adjusts itself automatically to 12V or 24V and 48V or 96V system voltage.
3. The charge controller has a number of safety and LED & LCD display functions.

Mounting and Connecting

The controller is intended for indoor use only. Protect it from direct sunlight and place it in a dry environment. Never install it in humid rooms (like bathrooms). The Controller measures the ambient temperature to determine the charging voltage. Controller and battery must be installed in the same room.

The controller warms up during operation, and should therefore be installed on a non flammable surface only.

REMARK: Connect the controller by following the steps described below to avoid installation faults.



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Mount the controller to the wall with screws that fit to the wall material. Use 4pcs screws with 3mm shaft and max.7 mm head diameter, no counter sink. Mind that the screws have to carry also the force applied by the wiring.

Make sure that the ventilator slits on the sides are unobstructed.

A DIN Rail mounting plate is available as an accessory. This allows mounting the controller on a standard 35mm DIN rail. Screw the mounting plate with the (long) fastening screw onto the double side of the controller.

②



Connect the wires leading to the battery with correct polarity, to avoid any voltage on the wires. First connect the controller, then the battery. Mind the recommended wire Length (min 30 cm to max approx. 100 cm) and suggest the wire size:

LM 01 min 6 mm²

LM 02 min 10 mm²

LM03 min 12 mm²

LM04 min 15 mm²

Wrong polarity will cause a permanent warning sound.

WARNING: If the battery is connected with reverse polarity, the load terminals will also have the wrong polarity. Never connect loads during this condition!

REMARK: Mind the recommendations of your battery manufacturer. We strongly recommend connecting a fuse directly to the battery to protect any short circuit at the battery wiring. The fuse must take the charge controller nominal current:

LM 01 30A

LM 02 40A

LM 03 50A

LM 04 60A

OHL05: 20A. CA4/08: 20A. CML70: 30A

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③



Connect the wires leading to the solar array with correct polarity. To avoid any voltage on the wires, first connect the controller, then the solar array. Mind the recommended wire size:

LM 01 min 6 mm²

LM 02 min 10 mm²

LM03 min 12 mm²

LM04 min 15 mm²

REMARK: Place positive and negative wire Close to each other to minimize electromagnetic effects.

REMARK: Solar panels provide voltage as soon as exposed to sun light. Mind the solar panel manufacturer's recommendations in any case.

④



Connect the wires Leading to the loads with correct polarity. To avoid any voltage on the wires, first connect the wire to the Load, then to the controller. Mind the recommended wire size:

LM 01 min 6 mm²

LM 02 min 10 mm²

LM03 min 12 mm²

LM04 min 15 mm²

Grounding the Solar System



Be aware that the positive terminals of the LM controller are connected internally and therefore have the same electrical potential. If any grounding is required, always do this on the positive wires.

REMARK: If the device is used in a vehicle which has the battery negative on the chassis, loads connected to the regulator must not have an electric connection to the car body. Otherwise the Low Voltage Disconnect function and the electronic fuse function of the controller are short circuited.

Starting up the Controller

Self Test

As soon as the controller is supplied with power either from the battery or the solar array, it starts a self test routine. Then the display changes to normal operation.

System Voltage

The controller adjusts itself automatically to 12V or 24V and 48V or 96V system voltage. As soon as the voltage at the time of start-up exceeds 20.0V or 80V, the controller implies a 24V or 96 system. If the battery voltage is not within the normal operation range (ca. 12 to 15.5V, or ca.24 to 31V, or ca.48 to 62V, or ca.96 to 124V) at start-up, a status display according to the section **ERROR DESCRIPTION** occurs.

Battery Type

The controller is preset to operate with lead acid batteries with Liquid electrolyte. If you intend to use a lead-acid battery with solid electrolyte ('gel' type or 'fleece' type) you can adjust the charging characteristics (see "Settings"). The equalization charge is deactivated then. In case of any doubts consult your dealer.

Recommendations for Use

The controller warms up during normal operation.

The controller does not need any maintenance or service. Remove dust with a dry tissue.

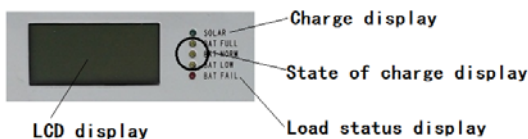
It is important that the battery gets fully charged frequently (at Least monthly). Otherwise the battery will be permanently damaged.

A battery can only be fully charged if not too much energy is drawn during charging. Keep that in mind, especially if you install additional loads.

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Display Functions in normal operation

The controller is equipped with 5 LEDs and an acoustic warning signal, also it have LCD display. By the LCD can display the voltage and the currents data directly.



In normal operation, the controller shows the state of charge of the battery and the charge from the solar panels. Any change of the state of charge (SOC) to a lower status is additionally signaled acoustically.

Charge display LED on: Solar array supplies electricity.

Charge display LED off: Solar array supplies electricity.

State of change display: BAT FULL LED on, battery available energy >75%

BAT NORM LED on, battery available energy 25%-75%

BAT LOW LED on, battery available energy 10%-25%

BAT LOW LED flashes: specially , battery available energy <10%

The percentage corresponds to the available energy until Low Voltage Disconnect in relation to a fully charged battery.

Load status display LED off: The controller is working in normal operation. The load work well also.

Load status display LED on: The battery is discharged deeply by the load, the load output is switched off.

Load status display LED flashes: overload/short-circuit of load, the load output is switched off also.

LCD Display: This LCD use blue back light, the currents is only 1 m A. The whole LCD circuit use less than 10 m A currents.

The LCD display the voltage and current directly. It's has 1% precision for currents and voltage. Such as below:



Acoustic signals: A change in the state of charge (SOC) to a Lower status is indicated by an acoustic signal. When the battery voltage is too low, the Loads are disconnected approximate 1 minute after a series of 25 signals.

Low Voltage Disconnect Function (LVD)

The LM series controller has 2 different modes to protect the battery from being deeply discharged:

1. State of charge controlled: Disconnect at 11.4 V (at nominal Load current) up to 11.9 V (at no Load current). Normal operation mode is for good battery protection.
2. Voltage controlled: Disconnect at 11.0 V fixed setting. Appropriate if bypass Loads draw current directly from the battery.

Note: Above, give you a 12V battery sample. For the 24V, 48V, 96V, you can use same ways to calculate the difference low voltage disconnect value.

The controller is preset to Mode I from the factory. Changing the mode setting is described below.

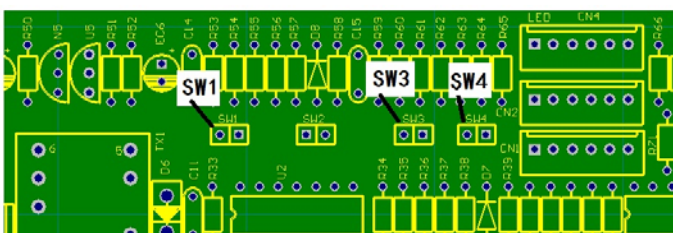
In case of doubts which mode to choose, consult your dealer because this has to be evaluated depending on the battery used Type.

Settings

The controller can be configured for special operation. For this purpose, open the cover of the controller by removing the screws on the box side.

WARNING: The controller should not be opened while connected and in operation!

When the controller is opened, there are 3 jumpers on the electronic board: SW1, SW3, SW4:



With these jumper to short or open the SW1, SW3, SW4 of the 3 groups both contact pins, the following setting can be configured:

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Jumper	SW3	SW1	SW4
Function	Battery type	Function of Low voltage disconnect	Acoustic alarm signal
Setting Jumper open	Liquid electrolyte	State of charge controlled	Alarm off
Setting Jumper closed	GEL (VRLA Battery)	Voltage controlled	Alarm on
Factory setting	Jumper open (liquid electrolyte)	Jumper open State of charge controlled	Jumper closed Alarm on

After completing the setting, replace the cover and tighten it with the screws.

Safety Features

The controller is protected against improper installation or use:

	At the solar terminal	At the battery terminal	At the load terminal
Battery connected With correct polarity	Unrestricted	Normal operation	Unrestricted
Battery connected with wrong polarity	Unrestricted	Unrestricted Acoustic Warning	Unrestricted
Reverse polarity	Yes, not at 24V, or 48V ,or 96Vsystem voltage	Yes, if only the battery is connected. Acoustic Warning	Load output is protected, but loads might be damaged.
Short circuit	Unrestricted	Unrestricted CAUTION: Battery must be protected by fuse.	Unrestricted
Over current	No protection		Controller switches off load terminal.
Thermal overload	No protection		
No connection	Unrestricted	Unrestricted	Unrestricted
Reverse current	Unrestricted		
Overvoltage	varistor 56V or 110V	Max. 40V, or 80V, or 160V	Controller switches off load terminal

Under voltage	Normal operation	Controller switches off load terminal	Controller switches off load terminal
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WARNING: The combination of different error conditions may cause damage to the controller. Always remove the error before you continue connecting the controller!

Error Description

Error	Display	Reason	Remedy
Loads are not supplied	BAT FAIL LED: Red LED on	Battery is low	Load will reconnect as soon as battery is recharged
	BAT FAIL LED: Red LED flashing	Over current/Short circuit of loads	Switch off all loads. Remove short circuit. Controller will switch on load automatically after max 1 minute.
	BAT FULL LED: Green LED on	Battery voltage too high (>15.5V/31.0V or >62.0V/124V)	Check if other sources over charge the battery. If not, controller is damaged.
		Battery wires or battery fuse damaged, battery has high resistance.	Check battery wires, fuse and battery.
Battery is empty after a short time	BAT FAIL LED: Red LED on	Battery has low capacity	Change battery

Battery is not being charged during the day	SOLAR LED: Green LED on	Solar array faulty or wrong polarity	Remove fault connection/reverse polarity
Battery wrong polarity	Permanent sound	Battery is connected with reverse polarity	Remove reverse polarity

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General Safety and Usage Recommendations

Intended Use

The charge controller is intended exclusively for use in photovoltaic systems with 12 V or 24 V, 48V or 96V nominal voltage and in conjunction with vented or sealed (VRLA) lead acid batteries only.

Safety Recommendations

1. Batteries store a large amount of energy, never short circuit a battery under all circumstances. We recommend connecting a fuse (slow acting type, according to the nominal controller current) directly to the battery terminal.
2. Batteries can produce flammable gases. Avoid making sparks, using fire or any naked flame. Make sure that the battery room is ventilated.
3. Avoid touching or short circuiting wires or terminals. Be aware that the voltages on specific terminals or wires can be up to double the battery voltage. Use isolated tools, stand on dry ground and keep your hands dry.
4. Keep children away from batteries and the charge controller.
5. Please observe the safety recommendations of the battery manufacturer. If in doubt, consult your dealer or installer.

Liability Exclusion

The manufacturer shall not be Liable for damages, especially on the battery, caused by use other than as intended or as mentioned in this manual or if the recommendations of the battery manufacturer are neglected. The manufacturer shall not be liable if there has been service or repair carried out by any unauthorized person, unusual use, wrong installation, or bad system design.

Technical Data

Model series	LM series A LM01A02A/03A/04A/05A/06 A	LM series B LM01B/02B/03B/04B/05B /06B	LM series C LM01C/02C/03C/04C/05 C/06C
Nominal voltage	12/24 V, automatic recognition	48/96 V, automatic recognition	36/72 V, automatic recognition
Boost voltage	14.5/ 29.0 V (25°C),2 hours	58/116V (25°C),2 hours	43.5/87V (25°C),2 hours
Equalization voltage	14.8/29.6 V (25°C),2 hours	59.2/118.4V (25°C),2 hours	44.4/88.8 V (25°C),2 hours
Float voltage	13.7/ 27.4 V (25°C)	54.8/109.6/ 27.4 V (25°C)	41.1/ 82.2 V (25°C)
Low Voltage Disconnect Function	11.4-11.9/22.8-23.8 V controlled by state of charge 11.0/ 22.0 V controlled by voltage	45.64-47.6/91.2-95.2V controlled by state of charge 44.0/ 88.0 V controlled by voltage	34.2-35.7/68.4-71.4 V controlled by state of charge 33.0/ 66.0 V controlled by voltage
Load reconnect voltage	12.8 / 25.6V	51.2/102.4V	38.4 / 76.8V
Temperature compensation	-4 mV/cell*K		
Max. solar panel current	30A/40A/50A/60A/80A/100A according to model number @ 50°C		
Max. load current	30A/40A/50A/60A/80A/100A according to model number @ 50°C		
Dimension	230 x 150 x 85 mm		
Weight	1kg-1.1kg	1.1kg-1.2kg	1.1kg-1.2kg
Max wire size	20 mm ²		
Self consumption	16mA	30mA	30mA
Ambient temperature range	-40 to+ 50°C		
Case protection	IP 22		

Subject to change without notice.